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TECHNOLOGICAL OPTIONS AND OPPORTUNITIES FOR DEVELOPMENT: A COMPARATIVE STUDY BETWEEN ALUMINIUM AND TIN **/

*/ This meeting is being carried-out within the framework of ECLAC/UNCTAD/PNUD Project - RLA/87/019, "Assistance for Commercial Development and Trade Negotiations".

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SUMMARY

In accordance with the approval by UNDP of the work program for Project "Assistance for Trade Development and Trade Negotiations" (RLA/87/019), two reports, one for each metal, on the impact of technological changes on supply and demand for tin and aluminium were undertaken by the Secretariats of ECLAC and UNCTAD (hereafter these reports are called the aluminium and tin study respectively). The general objective of these reports was to identify options open to the governments and industries of Latin American and the Caribbean countries with regard to the use of modern technology to improve the contribution of the tin and bauxite/alumina/aluminium industries to economic development, through the raising of export volumes, higher local processing, the generation of increased extra and intraregional trade and the strengthening of the technological and commercial capabilities of the industries concerned.

The selection of the two commodities was based first on a markedly contrasting consumption performance between them, suggesting for the need for examining the factors behind it. It was also based on the assumption that the main problems facing the Latin American tin industry relate to difficulties of raising productivity and in particular the high production costs, while the bauxite/alumina/aluminium industry has to contend with problems associated with the marketing and valorization of output. Through the findings in the two reports generally accord well with this original assumption, there are other technical and trade related problems, which are unique to the product or country in question or are common in both products. This present report tries to summarize and bring to light major differences and similarities between the two industries in order to draw some recommendations.

Chapter I surveys at the macro-economic level the past (principally 1978-1987) demand and supply performance of aluminium and tin and to portray the likely market environment (up to the mid-1990s) in which the two metals will be operating. Emphasis will be placed on the relatively satisfactory and disappointing demand record respectively of aluminium and tin in the last decades, testified by the analysis on the consumption growth rate against macro-economic fundamentals (e.g., industrial production versus metal demand).

The examination on supply and demand estimates until the mid-1990s suggests, however, a demand/supply balance substantially better for both metals when compared to the situation of the early 1980s.

Reference will be made on the intensity of use for both metals. From this analysis it should become clear that: (i) the intensity of use for the Developed Market Economy Countries (DMECs) will probably continue its downward trend for both metals; and (ii) while the consumption level of developing countries including those in Latin America might not reach the previous high levels achieved in the DMECs, a huge gap evidenced between developed and developing worlds in per capita consumption suggests that there are still high potential untapped markets for both metals in the markets of the latter group of countries. It will be argued that the declining overall consumption growth for the DMECs could be compensated for, to some extent, by increasing consumption in developing countries, if correct measures are taken and opportunities fully exploited. In this view, sincere efforts are to be made to take advantage of South-South, intraregional market opportunities.

Chapter II begins by summarizing the changing production and trade patterns of both metals at the international and regional levels. Two features (geographical relocation of the industry and the increased diversification of trade) and their responsible factors will be examined. Here, the response of the aluminium producers to the reduced economic growth rate in the 1980s and that of the tin producers to the crisis of 1985 will be a focal point. In the case of aluminium, one of the highest capital-intensive metal industries, still dominated by large and well-organized corporations, a major reaction was to relocate their supply towards lower-cost countries, to diversify into new or advanced materials related or not to aluminium. In the case of tin, after the crisis, the producers found few options but sought the exclusive possibility of reducing costs through the closures of a number of high cost mines, and measures such as selective mining, work force rationalization and stock reduction.

The lesser control exercised by the major aluminium producers contrasted to the seemingly increasing industrial concentration in tin might point to some convergent areas of concern for both metals. They include the maturing process of the industry, threat of material substitution, higher price volatility and consequently different price discovery and formation processes at different stages of processing, the need for the producers to increase value-added by local processing and through the introduction of new products and development of advanced materials in some cases.

A certain importance will be given to the process of materials substitution, examining its degree and mechanism. In addition to a summary on development in major end-use sectors of each metal and an examination of some end-uses in which both metals compete, the paper suggests that not only relative prices but also other input (labour, maintenance, recycling), costs and specific properties (weight, durability, anti-corrosiveness, extendability, etc) play an important role in facilitating/inhibiting substitution. In this context, concerted actions to establish price stability as well as to undertake joint R & D efforts are called for. Only under a stable price regime, endeavors to discover and promote new uses can be sustained.

In view of high market potentials in Latin America, it might be argued that a type of product differentiation now ongoing between the developed and developing economies will continue: while developing countries continue to exploit their comparative advantage specializing more in low-cost, low quality-end, bulk products in these metals, developed countries intensify their efforts to concentrate more on products with higher value-added with more special qualities and specifications. Depending on the nature of product specialization, not only the technology required but also marketing and distribution capabilities needed should differ. This casts in turn a series of questions regarding the future strategy of the companies concerned.

An examination in Chapter III on the cost composition of the industry-chain makes it clear, on the one hand, that for tin mineral resource endowment and efficiency and productivity in mining is the fundamental cost variable, and on the other, that for aluminium the cost of mining usually accounts for less than one per cent of the total cost of metal production. In other words, the mining stage of tin is the most relevant one, in contrast to aluminium which has its key phase in the smelting end and further downstream activities. In this sense, efforts to improve competitiveness of Latin American producers (notably Bolivia) must be directed to mining technologies.

Refining and smelting technologies in aluminium have in their principle remained largely unchanged since the beginning of the century. As a result, the production costs tend to converge across countries even though some country-specific features (labour and energy costs etc), play an important role in cost differentiation. The aluminium study supports the view that Latin American smelters are still far from the "best practice" regarding labour productivity, whereas a more than two-fold difference in productivity for some cases is offset by their substantially lower labour costs. The factors contributing to the low productivity should be identified and to be corrected.

In contrast, the tin study points out widely differentiated production costs among and within different mining methods (e.g., underground, dredge, gravel pumping). Revitalization of high cost producing countries like Bolivia and their ability to regain competitiveness against such an efficient producer as Brazil will depend principally on their ability to reduce mining costs. Furthermore, in countries where the concentrates are obtained from underground mines and which are for this reason chemically more complex, some technical improvements are needed before the stage of smelting. For these reasons, much greater cooperation through intergovernmental institutions and with private entities working in tin in the DMECs and the Third World to reduce technical bottlenecks is essential.

Chapter IV deals with issues on marketing and product promotion. The bauxite/alumina/aluminium industry, in spite of recent changes, has been characterized by its tightly controlled marketing system. Most bauxite and alumina continue to be traded between affiliated firms of the same companies. These companies still control a high percentage of fabricating capacities world-wide. In contrast, tin (ore, metal, tinplate) gets to final markets through trading agents and semi-fabricators, who are many in number, and whose interests are not necessarily only in tin. The lack of market information-feedback in tin therefore prevents the producers from assessing real and potential needs and requirements of final consumers. The change towards a lower degree of vertical integration in aluminium and the emergence of new entrants to the industry will also call for greater needs of these new participants for marketing and promotion.

It is ascertained that funds designated for R & D on basic research and applications in tin is totally deficient when compared to the case of aluminium. The ability to remain competitive in the mining and smelting stages of production and to bring to markets new/improved products is correlated heavily with the scope and nature of R & D, which is in large determined by funds availability. In this sense, it is crucial to strengthen financial bases of the due organizations through intergovernmental actions at the international and regional level or by seeking some support from such in-coming entities as the Second Account of the Common Fund. The Asian case of creating a regional organization (SEATRAD) could also be emulated in Latin America.

For aluminium, it could be maintained that intergovernmental support on R & D would have a modest impact, taking into consideration the activities of the major producers, who undertake these efforts efficiently with ample funds. Nonetheless, measures specifically oriented towards solving the problems of the industries of the region could bring about significant benefits.

Both aluminium and tin studies coincide in arguing that the promotion and marketing aspect is one of the fundamental variables for further expansion. There are known to exist important statistical gaps regarding consumption and fabricated products. There is also a recognized need for greater efforts to maintain/promote the attractiveness of these metals, through a better advertising campaign, and an increased awareness of individual market needs and potentials. In this regard, the development of marketing infrastructure, for example, through joint ventures with foreign companies in the region or elsewhere, should help to diversify not only market outlets but also transaction arrangements such as product sharing and buy-back deals.

The ongoing improvements in informatics have facilitated the development and integration of financial commodities and primary commodities at commodity exchanges where institutional investors revolve funds from one asset to another, depending not only on future market prospects of the commodity in question but also on world macro-indicators (e.g., exchange rate, interest rate). This phenomenon has been at least partially responsible for a wider price volatility of commodity prices in recent years, and has made it essential but more difficult risk management from the point of view of producers. This, in turn, calls for the development of trading entities equipped with highly capable market intelligence units. In this regard, international or regional action may be contemplated to assist the countries in the region either to participate more efficiently in these markets existing in the DMECs or to create their own.

The closing Chapter V will argue that though near future market environment and global production structure condition the producers of the region to be principally export-oriented to extraregional markets, there are opportunities, at least in theoretical terms, for increasing intraregional trade flows in these two metals and expanding co-operation efforts. Undoubtedly, to make a higher level of regional trade possible, in-depth economic and technical feasibility studies are called for. Furthermore, such constraints as tariff and non-tariff barriers, transportation difficulties, insufficient financing, lack of marketing abilities should be reduced.

The possibility for increasing intraregional trade seems to be higher for downstream products. However, higher level of processing requires a concurrent development of complementary industrial sectors and this is particularly true for the case in tin. A significant factor determining the processing level in tin is that this metal is an only material input in many of its major industrial applications. In the manufacture of tinplate and numerous tin alloys, which account for the majority of tin consumption, the larger proportion of the principal inputs consists of metals other than tin. This factor plays a major role in the location of processing industries. Therefore, greater progress towards the development of complementary metal sectors will have a positive effect on the consumption of tin and on the establishment of more integrated metal industries in Latin America.

I. COMPARISON IN THE BEHAVIOR OF DEMAND AND SUPPLY

1. Past Demand/Supply trends

Aluminium's most important properties are its low specific density, strength, corrosion resistance, electrical conductivity and relatively low melting point. These properties permit a wide variety of applications --more so than any other major metal. In short, aluminium is valued for its considerable conductive and structural properties relative to its weight.

Tin is one of the oldest commercially available materials, whose use goes back as early as 3 500 B.C. to harden copper. Several characteristics have been responsible for tin's early use: they include extraordinary malleability and ductibility at low temperatures, softness, tightness, corrosion resistance, antifriction properties and easy conductivity and fusibility. Thanks to these properties, tin can be easily rolled or beaten into their sheets or easily alloyed with other metals to create desirable properties. These properties also give tin a feature of "derived" demand since it is often used jointly with other metals or materials, unlike the case of aluminium.

A quick glance at annual growth rates of apparent consumption for non-ferrous metals over the last two and half decades (see Table 1) points out clearly a differentiated demand behavior between aluminium and tin. Aluminium, for both periods (1961-1986, 1970-1986), demonstrated in the DMECs and developing countries a growth rate substantially higher than any other metals, except for refined copper during 1970-1986 for the developing world. Tin, on the other hand, for both periods and for both developed and developing regions, has registered the lowest growth rate. This severely depressed demand performance has been a major concern of the tin industry.

During most of the post-war period, aluminium consumption increased rapidly, at a rate higher than industrial production. Its world consumption increased by an annual average of 8.5% from 1960 to 1970, followed by 4.5% from 1970 to 1980. In the DMECs, the average annual increase from 1960 to 1970 was about 8% whereas for the period 1970-1980, 4.0%. The high rate of growth in demand was due to the rapid expansion of aluminium consuming industry sectors, but also to the success of this metal in replacing other materials, such as copper, steel and tin, in different end-uses.

In the 1970s and early 1980s, a number of events led to a more reduced growth of demand for aluminium. The reduced rate of economic growth, particularly industrial production and the slow-down of substitution process of aluminium for other metals were major responsible factors. As a result, while aluminium consumption in the 1960s and 1970s increased at a rate about twice that of industrial production, in the 1980s so far the rate of increase has been only slightly higher than the rate of increase in industrial production. Global world aluminium consumption (including consumption of secondary metal) increased at an average annual rate of only 2.5% from 1980 to 1987. Consumption in DMECs grew only by 1.9%, against their GDP annual growth of 2.4% and industrial production of 1.7%. In 1988, global consumption is estimated to have increased by 3%.

In developing countries, aluminium consumption has continued to expand at a relatively high rate: from 1978 to 1987, total consumption increased at an average annual rate of 8.4% in Asia, 5.8% in Africa and 6.1% in Latin America and the Caribbean. In developing countries, the consumption growth was 9.2% per year from 1975 to 1980 and 7.1% from 1980 to 1987, in both periods exceeding the rate of growth in industrial production.

In contrast, due to its early introduction as an industrial metal, and thereby a relatively mature industry, world consumption of primary tin metal registered in the 1960s an annual growth rate of 1.0%, against the world GDP or industrial production growth rate of over 5%. Between 1975 and 1980, despite an average world GDP growth of 3.7%, global tin consumption grew at a modest annual average rate of 0.4%. The growth in tin metal consumption in the DMECs during this period was -0.2%. The rate corresponding to the DMECs for the period 1980-1985 was also negative, -2.2%. The DMECs' tin consumption actually decreased in 1986 as well and it was only in 1987 that it recovered to 126 200 tons, a level 14% lower than that of 1978.

As in the case of aluminium, developing countries have shown a much stronger demand for tin throughout. Between 1980 and 1985, for instance, despite deceleration in GDP growth of these countries, coupled by their mounting debt problems and the low prices for their commodity exports, tin metal consumption continued to grow at a rate of 3.4% (especially in Asia 5.7% and Latin America 1.6% while Africa had a negative growth rate of 1.3%). The period 1985 to 1987 saw a remarkable increase of developing countries' tin consumption, an average annual growth of almost 16%, against GDP growth 3.3% (1985-1986). The demand for 1988 and 1989 so far has remained strong. In sum, the consumption pattern of these countries has behaved much more favorably than that of the DMECs.

Table 1

TREND ANNUAL GROWTH RATE OF APPARENT CONSUMPTION FOR VARIOUS NON-FERROUS METALS */
(percentages)

	World		DMECs		Developing	
	1961-86	1970-86	1961-86	1970-86	1961-86	1970-86
Aluminium	5.2	2.6	4.4	1.7	11.1	7.7
Tin metal	0.1	-0.9	-0.9	-2.3	1.4	1.2
Refined copper	2.7	1.8	1.8	0.8	7.8	8.3
Nickel	3.4	1.9	3.0	0.9	6.2	6.2
Lead metal	2.5	1.3	1.4	0.2	5.6	4.5
Zinc metal	2.6	0.9	1.1	-1.0	6.7	6.2

Source: World Bank, Price Prospects for Major Primary Commodities, Report No. 814/88, Vol. III, November 1988.

*/ Least squares trend.

Table 2

GEOGRAPHICAL DISTRIBUTION OF BAUXITE/ALUMINA/ALUMINIUM AND TIN CONCENTRATES/METAL/TINPLATE PRODUCTION
(percentages)

	1978			1987			1978			1987		
	bauxite	alumina	alum.	bauxite	alumina	alum.	tin-in concen.	tin metal	tin plate	tin-in concen.	tin metal	tin plate
DMECs	35.2	63.8	69.8	39.9	57.7	60.1	8.4	14.8	86.9	9.1	13.0	79.7
North America	2.1	23.1	36.6	0.7	14.0	29.9	0.2	2.5	34.3	1.9	2.0	22.8
Western Europe	5.3	13.4	22.7	4.0	14.0	21.2	1.8	9.0	34.4	2.3	9.0	36.4
Japan	-	5.7	7.2	-	1.9	0.2	0.3	0.5	13.8	0.05	0.5	14.9
Oceania	27.7	21.8	2.8	35.2	27.7	7.8	5.0	2.2	2.5	4.2	0.3	3.0
Developing Countries */	51.5	18.7	8.8	48.6	22.3	19.0	75.4	69.0	11.0	64.8	63.5	18.3
Africa	15.7	2.0	1.7	18.4	1.5	2.5	4.3	1.9	0.2	2.4	0.8	0.3
America	28.6	13.1	2.8	22.4	15.7	9.2	16.5	11.5	7.2	23.0	18.0	9.1
Asia	4.3	2.0	3.1	4.3	2.0	5.6	54.6	55.5	3.7	39.4	44.8	8.2
SCEE	11.7	15.0	18.9	8.4	16.7	17.4	8.4	8.4	2.1	10.0	10.5	2.0
SCA	1.6	2.3	2.5	2.8	3.3	3.4	7.8	7.8	2.1	16.1	13.0	2.1
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
(1000 MT)	87 804.6	31 073.4	14 768.6	97 066.0	36 471.0	16 326.7	236.0	231.7	13 072.0	184.9	196.1	11 584.8

*/ Includes Yugoslavia

Regarding world supply (see Table 2), the bauxite/alumina/aluminium industry remains basically in the hands of by the DMEC producers, who accounted in 1987 for approximately 40% of bauxite, 58% of alumina and 60% of aluminium production worldwide. During 1978-1987, developing countries increased their participation in alumina and aluminium, while the share in bauxite decreased. This observation stands valid also for Latin America and the Caribbean. In contrast, in tin-in-concentrates as well as in tin metal, a major share is accounted for by the developing countries' producers, especially of Southeast Asia, while tinplate production continues to be a major domain for the DMEC producers. Both in concentrates and metal, Latin America has increased significantly their share in world production. For both aluminium and tin, socialist countries, though not dominant, occupy an appreciable share.

World production of tin-in-concentrates has undergone a number of shocks during the past decade. Output reached roughly 240 000 tons in 1981 --a period of rapidly declining consumption.*/ Attempts by the International Tin Council (ITC) to maintain prices through the build-up of stocks proved insufficient and export controls were introduced in 1982. Although all major producing member countries of the International Tin Agreement reduced output, purchases of tin for the buffer stock had to continue until, eventually, the Agreement ran out of funds in 1985..

Accordingly, world production of tin metal exceeded world consumption each year from 1978 to 1983 (see Table 3a) as high prices, supported by ITC intervention, led to high production and induced the substitution of other materials for tin, especially in the packaging industry. As a result, reported stocks at end-1985 were about 87 000 tons, and in addition, there were estimated to be about 15 000 tons in the hands of producers and consumers, bringing total stocks of over 100 000 tons, or the equivalent of more than 60% of annual consumption.

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*/ By 1940, world concentrates production was already well above 233 000 tons, similar to the figures of the late 1970s.

Table 3a

TIN METAL: WORLD COMMODITY BALANCE, 1978-1987
(1000 tons)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Production	231.7	238.7	232.5	232.1	217.8	199.0	201.8	201.2	193.9	196.1]
Consumption	222.7	223.7	212.2	201.6	195.0	196.1	207.5	208.0	215.4	220.1
Closing world stock of inwrought tin */	14	10	33	43	70	77	63	87	56	35
of which: ITC buffer stock	-	-	-	2	53	55	62	**/	-	-

*/ Includes stocks known to be in London Metal Exchange and other stocks with other consumers and producers, and excludes the United States strategic stockpile.

**/ When intervention was suspended on October 24, 1985, the ITC buffer stock held 52 540 tons.

Table 3b

ALUMINIUM: WORLD COMMODITY BALANCE, 1978-1987
(million tons)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Primary production	14.8	15.2	16.0	15.7	14.0	14.3	15.9	15.4	15.5	16.3
Primary consumption	15.3	16.0	15.3	14.5	14.2	15.4	15.6	15.9	16.1	17.1
Closing world stock of primary Aluminium */	2.1	1.5	2.1	3.3	3.2	2.5	3.1	2.8	2.2	1.7

*/ Includes stocks known to be in London Metal Exchange and other stocks with other consumers and producers, and excludes Japan's strategic stockpile.

The following contrast between the aluminium and tin industries brings to light the orderly development of production capacity of the former. Primary aluminium production continued to grow up to 1980 with 16.0 million tons. Though smelters were rather slow in cutting production in 1981, they faced the problem in 1982 and brought production down to 14.0 million tons, a reduction of 13%. Consumption of primary aluminium fell from 15.3 million tons in 1980 to 14.2 million tons in 1982 (see Table 3b), with the result that by the end of the latter year, current consumption was running at a higher rate than production. Stocks were gradually depleted and the foundation was being laid for later recovery in prices.

Although the major part of the cutback in production was accounted for by the forced closure of smelters that had become uneconomic, mainly because of high electricity costs, a share of the reduction was the result of production rate adjustments by the major producers. These companies are integrated into the production of semi-manufacturers to a much greater extent than the tin producers and are better placed to observe and respond to the state of final demand (these points are elaborated in Chapter IV).

2. The use-intensity hypothesis

Intensity of use is generally defined as consumption of a given input per unit of economic activity in constant prices. Its purpose is to isolate the impact on input demand of factors other than the size and growth of the national economy. It is typically expressed in tons (or kilos) per million of constant US dollars of GDP.

Intensity of use is strongly correlated with the level of economic development, as measured for instance by GDP/capita. In fact, intensity rises up to a certain threshold and then starts to fall as the economy matures.The main reason for this inverted U-shaped relationship is that after the material-intensive stages of infrastructure building and the development of manufacturing and metal working are largely completed, markets for traditional industrial products reach a certain degree of saturation. Thereafter, technologically sophisticated industries and services come to represent a more rapidly growing share of GDP. In addition, secular technological progress over time makes it possible to produce a given good with ever-decreasing material inputs, and a simultaneous rise in the value of knowledge, as well testified by experience of tin.

An important implication of the above concept is that even though many developing countries may continue to increase their shares in world output or trade of capital and consumer durables, their future materials demand and the use intensity would not necessarily reach the levels achieved in the past by the DMECs at comparable levels of income. But on the other hand, it also implies that developing regions, with a substantially lower level of intensity or consumption per capita, should present themselves as unexploited markets for many raw materials and semi-processed products for some time to come, pointing in turn to the importance of domestic, intra and interregional market expansion in the Third World.

An examination of use-intensity in the DMECs gives certain substance to the often-raised preoccupation over lesser demand coming from the combined shifts in the sectoral composition of GDP and in the material composition of output. In fact, the intensity-use in those countries for petroleum, steel, copper, tin and, to a lesser degree, lead and zinc (the case of aluminium is more ambiguous) has consistently declined during the last fifteen years. In developing countries, however, the intensity of use for aluminium has continued to increase while that of tin shows a slightly declining trend.*/ It is most likely that most developing countries find themselves at a development stage where the unit input of materials needed to produce an additional unit of GDP is to expand for some years to come. Any reductions in requirements of materials per capita thanks to miniaturization, economization and substitution, which are observed in most the DMECs today, would be likely to be offset by increasing requirements of materials, due to rapidly increasing populations, need for infrastructure building, materialism and consumerism in developing countries.

A fact-finding supporting the above argument is the large difference in per capita consumption between the DMECs and developing countries. In aluminium, both for primary aluminium and for semi-manufactured products, the difference is enormous: the highest consumers such as the United States and the FRG spend over 18 kg of primary aluminium per person whereas the NICs are still in the range of 3-8 kg (see Table 27 of the aluminium study). In the case of tin as well, for primary tin metal and tinplate, there exists a wide spread: for instance, the DMECs in 1987 consumed 0.16 kg and 9.91 kg per person of tin metal and tinplate respectively, but the corresponding figures for developing countries were 0.01 kg and 1.18 kg (Table 50 of the tin study).

It still remains true that developed countries account for the major share of world aluminium and tin consumption. However, it is also true that during the past quarter century, the developing countries (including China) increased their share of non-COMECON GDP from 19% to 24% in 1988. This modest

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*/ Consult United States of America, Bureau of Mines, Department of the Interior, Changes in World Demand for Metals, 1986, Washington D.C., Murray, Stewart, "Base Metals Demand and the Developing Countries", CIPEC Quarterly Review, October-December 1988. For the case of Latin America, see ECLAC, The Potentialities of Present Technological Capabilities in the Latin American Commodity Sector (LC/L.505), Santiago, Chile, June 1989.

change has brought with it a notable increase in the developing countries' share of world metals demand. As indicated in Table 4a and Table 4b, developing countries taken as a whole have been increasingly occupying a larger share in world consumption, both in aluminium and tin. It is noteworthy that in these steady share increases, Latin America has played an important role. The above observations, which are not even adjusted for the metals contained in the net trade flow of semi-manufactures and manufactures, clearly suggest that developing countries do play a substantive role in determining the level of world metals demand, including aluminium and tin. And these percentages should have been higher when the fall in investment as a proportion of GDP which took place after 1982 in the Third World had been taken into account. Therefore, the combination of rising intensity of use and rising industrial production could be a potential force in sustaining world demand of these metals.

3. Development of supply and demand until the mid-1990s

The World Bank */ projects that world primary aluminium consumption grows at an annual rate of 1.5% from 1987 to 1995, and 1.4% when socialist countries are excluded.**/ The aluminium study maintains that these estimates are on the conservative side, in view of the assumptions made by the Bank and the most recent demand development --in fact, a recent report by a private consulting firm forecasts an aluminium consumption growth of just under 4% per year until the mid-1990s. The Bank sees that the relative strong growth from 1982 to 1987 as basically a cyclical phenomenon and considers it unlikely that the growth

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*/ See World Bank, 1988, Price Prospects for Major Primary Commodities, Report No. 814/88, Washington, D.C.

**/ The recently revised World Bank projection forecasts (see Half-Yearly Revision of Commodity Price Forecasts of the Bank published in July 1989) world primary aluminium demand to a 1.7% p.a. growth rate during 1988-2000 period. Consumption in the industrial countries is expected to increase by 1.2% p.a., while developing countries should exhibit a 3.0% p.a. increase. The Bank lists for the slow consumption growth the following factors: (i) substitution by plastics and other competitive materials; (ii) generally mature markets; and (iii) the absence of important new applications.

Table 4a

GEOGRAPHICAL COMPOSITION OF PRIMARY ALUMINIUM CONSUMPTION (%)

	1970	1975	1980	1983	1985	1987
DMECs	73.0	66.4	68.3	66.7	66.0	65.2
LDCs*/	6.1	8.8	10.1	11.6	12.9	14.4
Africa	0.2	0.5	0.7	0.8	0.8	0.8
America	2.0	3.6	4.0	3.6	4.4	4.9
Asia	2.9	3.5	4.3	6.1	6.2	7.5
SCEE**/	18.6	20.8	17.8	17.4	16.4	15.4
SCA***/	2.3	4.0	3.8	4.3	4.7	5.0
Total (1000 MT)	10027.6	11457.2	15304.5	15281.5	15917.2	17201.1

*/ Including Yugoslavia
**/ Socialist Countries of Eastern Europe
***/ Socialist Countries of Asia

Table 4b

GEOGRAPHICAL COMPOSITION OF PRIMARY TIN METAL CONSUMPTION (%)

	1970	1975	1980	1983	1985	1987
DMECs	73.4	67.0	64.8	59.8	59.1	57.3
LDCs*/	8.5	9.9	11.0	12.8	13.4	17.0
Africa	0.6	0.8	0.8	0.7	0.7	0.7
America	3.3	4.6	5.1	5.7	5.8	7.0
Asia	4.5	4.5	4.6	5.8	6.2	8.6
SCEE**/	14.6	18.8	19.4	21.8	21.7	19.5
SCA***/	3.4	4.3	4.7	5.6	5.8	6.1
Total (1000 MT)	209.3	207.1	212.2	196.1	208.0	220.1

*/ Including Yugoslavia
**/ Socialist Countries of Eastern Europe
***/ Socialist Countries of Asia

rate in most end-use sectors will remain at the same high level. The Bank also assumes that recycling of aluminium will increase as a proportion of consumption. It is noteworthy that the Bank projections are based on a 1987 consumption estimate which is about 100 000 tons lower than actual consumption of the same year and which neither takes into account the continued strong growth in consumption in 1988. Nonetheless, it is undeniable that the aluminium industry will have to operate in a market environment much less favorable than two decades ago.

The supply/demand balance for primary aluminium made in the aluminium study suggests that the "probable" capacity increases envisaged for the period up to the mid-1990s would be sufficient to cover non-socialist demand. Given the relatively high implied capacity utilization rates for primary aluminium and alumina, it would also appear that these on-stream projects would be assured of markets. If a higher rate of consumption growth, for instance, 2% in lieu of 1.5%, is attainable, it would imply a capacity utilization rate for smelters at 93.2%, a rate that would be difficult to maintain over a long period of time. Thus, some of the projects included in the "possible" category could be realized (for details, see Chapter III of the aluminium study).

Based on these projections, the exportable surplus of the Latin American and Caribbean bauxite/alumina/aluminium industry would be in the order of 1.8 million tons per year (65% of production capacity) for aluminium, 3.5 million tons (just under 40% of capacity) for alumina, and 15 million tons (about 40% of capacity) for bauxite. These figures suggest therefore that even with rapidly growing regional consumption, the industry will have to remain competitive at all stages of production to ensure markets outside the proper region.

According to the projections of the World Bank, global primary tin consumption will decline at an annual rate of 0.7% during the 1987-1995 period, and this rate will worsen to 0.9% to the year 2000. Its consumption in the DMECs is projected to decline by 1.7% p.a. during 1987 -1995 and 2.0% to the year 2000, while that for developing countries is estimated to increase at a rate of 1.4% and 1.2% for the respective periods. These rates seem to reflect, on the one hand, the low long-term price elasticities of demand for tin, even after the projected low real prices of tin, and on the other, the continuing technological developments.

It should be stressed that the Bank's assessment is based principally on past performances and severe negative trends of world tin consumption, particularly of the DMECs. In addition, as in aluminium, their projections are based on an estimated 1987 world consumption which is much lower than actual reported consumption. Furthermore, they do not take into consideration the significant increase in tin demand in 1988 and 1989 in the DMECs. The tin study, on the other hand, argues that with tin prices remaining around the expected equilibrium levels and continued R & D on the uses of this metal, it is reasonable to expect that over the medium-term consumption level will be maintained at the current level. On balance, the prospects for tin should remain reasonably good, at least in the short-run, and current indicators point to a much more encouraging outlook than several years ago.

With respect to future supply/demand balance, for both tin metal and tinplate, there exists a high level of excess idle capacity around the world. For primary tin metal, less than 50% of world installed smelting capacity is actually in operation (see Table 60 of the study), one reason being the sharp decline in world tin-in-concentrate output. As a response to the 1985 crisis, worldwide mine output declined sharply until 1987 as many high-cost producers stopped their mining. With the situation of excess capacity being greater in developed rather than developing countries, coupled wish developing countries' efforts to integrate forward, the present on-going shift in tin smelting towards highly cost-effective smelters located in developing countries should be speeded up. However, owing to the actual and future production capacities and the projected growth of demand not only at the global level, but also for the region, it seems certain that the Latin American tin industry, like the case of aluminium, will continue to be export-oriented and rely mainly on outside markets in order to ensure its survival and development.

II. STRUCTURAL CHANGE AND RESTRUCTURING OF THE INDUSTRY

1. Restructuring in aluminium

This industry in the 1960s and 1970s was characterized by a high degree of vertical integration from bauxite mining to semi-fabricated aluminium production, the major actors being the six transnational corporations: Alcan, Alcoa, Alusiusse, Kaiser, Pechiney and Reynolds. In 1970, they were responsible for 63% of bauxite, 66% for alumina and 54% for primary aluminium production capacity in non-socialist countries. As a consequence, the proportion of trade taking place between parties not affiliated with these companies was relatively small and the "free market" represented only a modest share of total trade. Mainly due to the restructuring process, however, at the end of 1987, these ratios were reduced to 37% in bauxite, 59% in alumina and 45% in primary aluminium capacities, still a stronghold being maintained in alumina.

The present decade has evidenced the establishment of new non-integrated producers at the primary metal stage. This was accompanied by the major producers' change in strategy, as a response to the decelerating demand, which was earlier based on low profit margins and high rates of sales growth, to the one based on higher value-added or diversification into other metals, or to a lesser extent, higher mark-ups. These changes therefore led to the emergence of a two-tier structure where the older companies utilize their comparative advantage in the production of specialized products, while leaving the relatively less sophisticated, standardized production to the newcomers. Nonetheless, the major companies, Alcoa and Pechiney in particular, continue to remain as main suppliers of technology to new producers.

As indicated, the change towards a lower degree of vertical integration resulting from the decline of the majors in the share of world production capacity had led to an increase in the size of the free market. Several of the six companies have large amounts of surplus alumina capacity to their own requirements. The excess alumina is absorbed by the non-integrated aluminium companies, but a major portion is also toll smelted on behalf of traders. It has been estimated that about 1.3 million tons of alumina were treated on a tolling basis in 1987 in the United States alone. The increase in tolling operations seems to be one of the most significant development in the last few years.*/

Particularly at the bauxite and alumina stage, the concentration has been lessened by the establishment of consortia. In these, usually consisted of dozens of members, no single party can exercise complete control, as opposed to the earlier practice. As these consortia are usually established on the basis of "take or pay" agreements, in which participants are in effect obliged to accept their shares of production in proportion to their ownership, and if they do not take in the products, sell them on the open market.

Aluminium prices were generally stable during the 1960s and 1970s, reflecting the marketing power of and the recognition by the majors that stable prices offered an advantage in the competition with other materials. In the absence of any commodity exchange quotation for aluminium, and given the dominant position held by the majors, the published producers' were closely followed by other market participants. However, the introduction of aluminium trading at the London Metal Exchange (LME) in 1978 and New York Commodity Exchange (COMEX) in 1983 brought into being attractive bases for price quotations. This led to greater uncertainty about future prices and contributed to decreased price stability.

Since more than 75% of bauxite output is traded between related parties and the greatest portion of that by the six majors, the pricing of bauxite involves some degree of "transfer pricing". Alumina is mostly traded between different parts of the same company (roughly 70% of total consumption) although many firms adopt a "market" value for the alumina and the alumina traded between unrelated parties are influenced by the price and market situation of the primary metal. Given that bauxite and alumina are usually traded under long-term contracts, an increasing trend to link prices in long-term contracts for the supply of alumina, and to a smaller degree, of

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*/ Notwithstanding these developments, the industry is still characterized by a predominance of long-term contracts. This is the case also for tolling operations, which are usually based on contracts covering several years. The importance of counter-trade also appears to be increasing, in the particular as regards trade among developing countries and trade involving socialist countries.

bauxite, to the aluminium price has transferred to some degree the volatility of this price to alumina and bauxite.

The events taking place during the 1970s and early 1980s brought with them a major geographical redistribution of production capacity (consult again Table 2). Developing countries' share in bauxite production has decreased from 51.5% in 1978 to 48.6% in 1987. The Caribbean has lost its predominance, partly for cost reasons and partly because of the governments' tax legislation and the introduction of export levies to obtain a higher share of their export income. Alumina production has tended to move closer to bauxite production sites, in order to benefit from lower transport costs. As a result, the share of the DMECs in its production has decreased from 63.8% to 57.7% during 1978-1987, mainly through the refinery closures in the United States and Japan. Similarly, the share of developing countries in production of primary aluminium increased appreciably from 8.8% in 1978 to 19.0% in 1987. New capacities were located in countries with low energy costs, such as Australia, Brazil, Canada, Norway and Venezuela. Despite recent changes, however, the Latin American and Caribbean countries are generally involved in only part of the production chain of aluminium. This and the fact that the region is a smaller consumer tend to still characterize these countries as minor participants in the industry.

The geographical relocation, which has taken place under the pressure of excess capacity and rising production costs, has resulted in the elimination of the highest cost producers and has led to a situation where the cost curve is flatter than it was in the 1970s. Although excess capacity still exists at the bauxite stage, the surplus is smaller, and the cost cutting efforts by most producers have reduced "swing capacities".

As accompanying results of the on-going restructuring of the industry, Latin American and Caribbean exports of bauxite, alumina and aluminium have undergone substantial changes. Their traditional dependence on the North American market have decreased somewhat at most stages, with Western Europe and Japan assuming greater importance as their export destinations. Bauxite exports have been more diversified with significant quantities now going to Western Europe and socialist countries. The export patterns and volumes of alumina have remained relatively stable, while for aluminium, total exports have increased rapidly. The most striking increase has been in exports to Japan, where Latin American countries have managed to capture an appreciable portion of the market created by the closures of all but one Japanese smelter. The region's exports of semi-manufactures products, still small in quantity, have also increased rapidly, with the United States as the major market. In contrast, intraregional trade in these products has remained of moderate proportions.

In short the main developments in recent years of the aluminium industry include a major geographical redistribution of production capacity, a decrease in the degree of industrial concentration, growth of the open market and increase in price instability, and a reduced capacity of substitution for other materials. As recognized later, these new features of aluminium have been and will be shared by the tin industry, of course in a varying degree.

2. Restructuring in tin

A notable aspect of ownership in this industry, distinct from that of bauxite/alumina/aluminium, is that they are few "captive" sources of supply. The transnational corporations involved in tin smelting do not usually own large-scale mining operations which are tied down to provide shipments of concentrates to parent smelters. There are, however, some exceptions, notably in Brazil and Thailand, where some transnationals own important capacities in both the mining and smelting sectors. Even in these cases, the integrated operation has not hampered the expansion of independent smelting capacities. To reemphasize, the majority of production capacities of tin concentrates and metal are located in developing countries, being clearly distinct from the case of aluminium.

The ownership structure in the tin industry has undergone substantial changes over the past decades, with increasing assets in the mining and smelting sectors under the control of tin-producing developing countries. Because of the different policies pursued by individual countries, however, the resulting ownership pattern has also shown wide structural variety: for instance, in Bolivia, the industry is largely owned by the State, while in other countries, government intervention, although without nationalization, has also played a major role in increasing national participation in ownership. In Brazil, government intervention has been largely avoided, leaving the industry in the hands of private enterprises, national or transnational.

International vertical integration is not common in tin. Though the market economies' supply of tin is dominated by large producers, ownership of refining and smelting facilities is more diffused than in some other metals such as aluminium. Since mining and smelting operations have mostly been independently owned, the marketing is done on an arms' length basis. The bulk of tin concentrates traded internationally is handled either directly by the producers or indirectly through trading companies. The bulk of trade in tin metal has traditionally been conducted by international traders, and their role as intermediaries is more important in tin metal than concentrates, mainly due to a diversified use of tin at the consumer level. Tinplate trade is also mostly conducted on an arms' length basis since there is rarely either forward or backward integration between tinplate manufacturers and can-making companies, who are major users of tinplate.

Although the forces behind the restructuring of the world tin industry were at work since the 1970s, it is only in recent years that its need became apparent and imperative. It was triggered by the collapse of the International Tin Council and the suspension of tin trading in the LME. Until 1980, the price of tin, in real terms, had steadily increased, although its demand declined. In the past, its price was determined basically by institutional factors than by the interplay of market forces. Under a long history of international commodity agreements, export quotas were used whenever a gap between demand and supply emerged. As a result, tin is the only major metal for which the price had increased continuously in real terms for more than three decades.

In contrast to the tin prices maintained artificially high, the price of aluminium continued to drop in real terms (see Table 5), propelled by improved technologies and greater economies of scale in production. In part, the strategy of the major aluminium companies was to keep their prices low and stable but the main thrust of their policy was to establish price differential against the substituting competitors, such as tin, based on the high level of vertical integration. As seen from Table 5, over the years the price differentials between aluminium and tin has widen markedly in favor of the former.

The maintenance of relatively high prices in the past did not stimulate the tin producers to reduce their costs of production in line with what was happening with other metal producers. The consequence of the market collapse was that most traditional producers started to operate at a loss. In fact, production had already been cut by 30% between 1981 and 1985 by the Southeast Asian countries as a whole, showing that a significant portion of their mine operations was already uncompetitive. Paradoxically, after the tin collapse, a significant number of producers increased their output. In part this action was an attempt to compensate for the drastic reduction in profit margins by increasing output.

This was also the situation of Latin America. The world's second largest tin concentrate producer for many years, Bolivia's concentrate production had also been drastically reduced since 1981 owing to a mixture of technical and administrative factors. In contrast, Brazilian production, stimulated by favorable world tin prices and the discovery of the Pitinga deposit, increased its production significantly, more than compensating for the reduced Bolivian output and thereby contributing to the increased total of the regional output. In fact, in 1988, Brazil emerged as the world's largest tin producer.*/

Another common reaction to the depressed prices of the post 1985 period was the adoption of selective mining, a practice which aims at cost reductions by concentrating extraction on the higher grade zones of the deposit. In the short-run, this practice may be justified on the ground of the survival of the firm involved, but in the longer perspective, it shortens the mine's life and reduces the overall quantity of metal recoverable from a particular deposit.

The structural changes in tin are therefore characterized principally by the consolidation of its industry following the 1985 tin crash, which led to closures of several high cost tin producers around the world, as well as by

*/ According to the latest figures from the ATPC, Brazil produced 44 020 tons of tin-in-concentrates in 1988, followed by Indonesia with 29 590 tons and Malaysia with 28 866. Therefore, for the first time in a century, Malaysia has been dethroned as the world's number one tin producer.

the emergence of some new tin producers such as Brazil and China. Coupled with the marked increase in smelting capacity in developing tin producing countries, these have resulted in significant changes in the pattern of world supply and trade for both tin-in-concentrates and primary metal.

Table 5

REAL PRICES a/ OF ALUMINIUM AND TIN: THEIR COMPARISONS
(1985 constant $)

	Aluminium b/ $/Ton (*)	Tin c/ $/Ton (**)	Ratio (*)/(**)
1960-1964	1529	8500	0.180
1965-1979	1530	10660	0.144
1970-1974	1326	10440	0.127
1975-1979	1310	13650	0.096
1980-1984	1366	13460	0.101
1985-1987	1138	11950 d/	0.095

a/ Deflated by Manufacturing Unit Value (MUV) Index.
b/ Certain other transaction, United States shipments to Europe, Min. 99.5%, CIF Europe.
c/ LME Settlement Price, standard grade.
d/ 1985 figure only.

The best-grade tin concentrates are mostly produced in the major tin-producing developing countries, an important exception being Bolivia whose tin content in concentrates is substantially lower and chemically more complex to process than that of other producing countries. In the 1970s Bolivia was still one of the major concentrate producers least vertically integrated into smelting. Tin concentrates are today mostly smelted into metal in the countries of production (see Table 2), much more than the case of bauxite/alumina, with the result that they export their tin now mainly in metal rather than in concentrate form, a major exception being Bolivia, who at one time was able to process in-house 80% of the domestic concentrate production but in 1987 processed only 25%. In Brazil, due to its accumulated processing capacity to meet its domestic metal consumption and to its ore relatively free of impurities, its smelter/mine output ratio is extremely high. Peru, the third tin-in-concentrate producer in the region, does not have any smelting capacity so far, exporting all its concentrates mainly to the United States.

Tin metal is a highly export-oriented product: in 1987 more than 81% of world production was traded internationally much so than in aluminium, and exports from the developing regions still occupy (Table 6), a dominant though declining share (72%). In general, the deployment of smelting capacity has contributed to strengthen the importance of producing developing countries as exporters of tin metal, as in the case of Brazil, while Bolivia's exports in this product declined from a peak of 17 100 tons in 1982 to 1 800 tons in 1987. A majority (81% in 1987) of tin metal exports from developing countries are absorbed by DMEC markets. Though no significant change in this trade pattern is expected throughout the 1990s, the position of the traditional Southeast Asian producers should diminish as Brazil increases both tin output and exports. Nonetheless, taking into consideration the fast growing tin metal imports by developing countries --in 1987 accounting for 18% of world imports-- their markets could be a vital source of trade growth in this product, should the economic downturn in the 1980s experienced in a majority of these countries be reverted.

Most of the world production of tinplate, a major tin application, is consumed domestically, with international trade representing roughly 31% of world production (see again Table 6) in 1987. Consumption in the DMECs has reached a peak in 1982 showing a clear declining trend since then. The DMECs are large tinplate exporters --still responsible for 90% of world trade, whereas developing countries as a whole are important importers of this product, absorbing close to 35% of world trade in 1987. The decline in developing countries' tinplate imports evidenced in recent years reflects on the one hand the increase in their production capacity, and on the other, the impact of the economic slowdown, accompanied by severe cutbacks in total imports.

As far as the Latin American and Caribbean tin producers are concerned, reliance on the North American market, especially the United States, for exports of tin-in-concentrates and tin metal has been reinforced in recent years, unlike the case of aluminium. But with respect to intraregional trade in concentrates and metal, it has failed to expand, sharing the same fate as in bauxite/alumina/aluminium. For tinplate, however, although the share of Latin American exports to the region has declined from 83% in 1978 to 17% in 1987, actual tonnages exported increased markedly from 8 800 tons to 21 700 tons during the same period. Tinplate exports to the United States, despite higher volumes exported, have been contained due to the country's import quota on tinplate, forcing the countries of the region to search for new markets, especially in other developing countries and socialist regions.

In summing up, the problems facing the aluminium and tin industries are of different nature and are rooted in the factors specific to each industry. However, they are somehow linked to the worldwide economic slowdown and the severe drop or break in the rate of metal consumption. As seen earlier, the industry structure is quite distinct, in terms of size and number of major participants, degree of vertical integration, pricing mechanism, etc. In the case of aluminium, one of the highest capital-intensive metal industries, dominated by large and well-organized corporations, a main reaction to the slowdown was a change in strategy. This involved relocations of supply towards lower-cost countries, reduction, in some cases, of backward integration, diversification into new or advanced materials related or not to aluminium, and, in some cases, increasing the R & D spending. In the case of tin where, the key element is the mineral resource endowment, producers found few options but sought the exclusive possibility of reducing costs of production through the closures of a number of high cost tin mines, and measures such as high-grade or selective mining, work force rationalization and reduction of stock.

Table 6

GEOGRAPHICAL DISTRIBUTION OF BAUXITE/ALUMINA/ALUMINIUM AND TIN/CONCENTRATES/METAL TINPLATE EXPORTS

(Percentages)

	1978			1987			1978			1987		
	Bauxite b/	Alumina	Alum.	Bauxite	Alumina	Alum.	Tin-in c/ concen.	Tin metal	Tin plate	Tin-in c/ concen.	Tin metal	Tin plate
DMECs	23.9	63.7	72.9	16.9	71.2	63.8	30.9	12.4	94.3	29.3	17.2	90.1
North America	...	6.1	22.5	0.6	6.8	19.8	2.2	0.3	9.7	6.5	0.8	4.0
Western Europe	5.2	10.2	47.3	4.4	15.5	34.2	6.1	10.8	56.8	6.2	16.2	60.0
Japan	...	1.3	1.3	...	1.1	...	...	0.1	25.1	...	0.1	24.6
Oceania	18.6	46.1	1.8	11.9	47.8	9.8	17.2	1.2	2.7	14.3	0.1	1.4
Developing Countries a/	74.1	31.2	11.4	80.0	25.2	23.6	69.1	84.4	1.3	57.7	71.7	6.8
Africa	33.0	4.4	4.3	46.2	3.2	3.9	12.7	2.9	...	6.7	1.3	0.1
America	34.9	25.8	1.8	29.0	19.0	11.1	36.8	10.0	0.3	29.3	14.4	3.3
Asia	4.3	0.3	4.0	3.1	0.5	6.5	19.6	71.5	1.0	21.7	56.1	2.5
SCEE	1.7	5.0	15.6	1.3	3.8	11.8	...	3.1	0.1	...	...	3.2
SCA	0.3	0.7	...	1.7	0.6	8.2	...	...	4.5	12.9	11.1	...
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total exports (a) (1000 MT)	34 495	13 832	4 337	32 857	17 385	7 336	41	172	3 252	43	159	3 648
Total production (b) (1000 MT)	87 804	31 074	14 769	96 742	36 471	16 327	236	232	13 072	185	196	11 585
(a)/(b) x 100	39.3	44.5	29.4	34.0	47.7	44.9	17.4	74.1	24.9	23.2	81.1	31.5

a/ Includes Yugoslavia

b/ Gross weight

c/ Estimated SN content

Given the situation that the tin producing countries are usually integrated into metallurgy, they could be considered, to a certain extent, to be able to exercise a more active role, in comparison with aluminium producing countries, in determining the destiny of the industry. Since the mineral resource endowment is the fundamental variable, the producing countries and their respective producers can play a significant role, as testified recently, for instance, through producers' cooperation in the Association of Tin Producing Countries (ATPC) forum in reducing output.*/ However, as in aluminium, tin consumption is concentrated outside the developing regions. Furthermore it is heavily influenced by concurrent developments in other complementary metal sectors.

3. Comparative advantages and the international division of labor

The nature and scope of R & D activities of major aluminium producers has increasingly become concentrated on development of new alloys and production processes for specific end-uses, and general material research. These types of R & D are geared to more stringent user specifications and qualities, necessitating the "tailoring" of materials to specific end-uses. Given the lack of developing countries' commercial contacts with final consumers as well as the technological know-how to be competitive in these highly specialized markets, a certain type of international division of labor might develop, with developing country producers supplying bulk products, while the more profitable specialty products being produced exclusively by the DMECs producers.

Tin has three major end-uses which together account for most of the consumption of tin metal in the world. They are tinplate, tin alloys and chemical compounds. The remaining end-uses consist mainly of wire tinning and

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*/ The ATPC's supply rationalization scheme under export quotas aimed at reducing the overhang of stocks has been influential on the recuperation of, but not high in real terms, tin prices. This association groups Indonesia, Malaysia, Thailand, Bolivia, Zaire, Nigeria and Australia, which together account for 60% of non-communist tin supply. Brazil, now the world's largest producer, and China, both non-ATPC members, have also participated in limiting output in support of the scheme.

wrought tin in the form of foils, sheets, collapsible tubes, pipes, capsules, etc.

As was seen earlier, some progress has been made in expanding tinplate production and its trade in developing countries but the market for tinplate continues to be dominated by the DMECs. Solders, the second largest use of tin, are used for joining together metals in a number of appliances such as radios, televisions, computors, heat exchangers,food cans and plumbing. Tin alloys consists mainly of white metals (babbitt), aluminium tin alloys and tin bronzes (see Table 6 and 51 of the tin study). The largest part of tin alloys is consumed to make wrought products or components which go into machine tools, electronics and other engineering products. Tin alloys often enter the world trade indirectly as part of these products which constitute an important export item for the DMECs and some newly industrializing economies. Where tin alloys are traded, such trade is confined mainly to the DMECs trading among themselves. Also, the larger proportion of production and trade in other end-uses (e.g. chemical compounds, wrought tin and tinning) is attributed to the DMECs. The production of developing countries is concentrated in the form of foil, plates, sheets, tin strips and articles of personal adornment, which are generally of low value-added. In view of these observations and given the more recent product development efforts mainly taking place in the DMECs*/ (consult Chapter III of the tin study), in tin as well, there will be a continuing trend for developing countries to specialize in the production of certain groups or components which are at the lower end of the quality or value-added scale.

4. Substitution

Aluminium is used in a multitude of applications. As opposed to other metals (like tin), demand for aluminium does not depend on events within one or two narrow end-uses, and is more resistant to substitution. On the other hand,

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*/ New uses of tin, as in cast iron and in powder metallurgy have shown a significant increase in recent years, as the cost effectiveness of tin is often greater, because relatively small quantities have an important benefit in high cost applications.

only in some small sectors is aluminium protected from substitution, in the sense that its technical superiorities are not so marked that relative prices would play only a subordinate role. Indeed, aluminium is increasingly subject to strong competition from potential substitutes in almost all market segments.

Also noticeable in aluminium in recent years is the slacking in pace of substitution of this metal for other materials. The major new market to appear in the last decade is the beverage-can sector,*/ where aluminium has replaced tinplate in several countries and where its market share is likely to expand further. In most other end-uses, aluminium has only been able to keep its market share or, in some cases, to increase it marginally. Technical advance, including the development of better alloys and design changes to use less aluminium in a given product, has also had a demand damping effect. In short, both aluminium and tin industries are now subject to stiff inter- and intra-industry competition.

The substitution of tin by other competing materials including aluminium and steel has been one of the major factors behind the decrease in world tin consumption. For the major DMECs (see Table 7 of the tin study), it appears that tin consumption has decreased in almost all end-uses, with an -2.2% annual average growth rate between 1978 and 1986, with the exception of solder and other uses.

Tinplate, traditionally the tin's largest end-use sector with a share of 38% of the major DMECs' consumption in 1978, decreased by an annual average rate of -5.8% and in 1986 represented only 28%.**/ This was partly due to the substitution by steel and aluminium in the packaging sector and in beverage cans. Solder has become the largest end-user, thanks principally to the rise in the use of the electronics industry and increasing environmental concerns on the use of lead in canned foods and plumbing industry. Other uses of tin

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*/ An examination on aluminium consumption in different end-uses among DMECs shows that although the packaging sector has been the most dynamic sector, there are wide variations among the countries with respect to the importance of each end-use.

**/ It should be also noted that technological advances in electrolytic processes have reduced the quantity of tin required per square meter of tinplate.

also increased during 1978-1987, especially the chemical sector for the production of PVC stabilizers.

The price of tin has been one of the key factors which brought the tin consuming industries to search for cheaper alternative materials. The significantly elevated real price of tin, compared to that of aluminium or copper, has had a traumatic effect on its consumption. Recently adjusted price levels have stimulated demand in 1987 and 1988, together with higher industrial production in the DMECs.

A demand/supply factor which has assumed increased importance in the last decade is recycling of aluminium. On the global scale, the use of secondary aluminium increased from 21.5% of total consumption in 1978 to over 26% in 1987. The increase in scrap use is partly accounted for by the fall in the rate of increase of aluminium consumption since the supply of scrap is a function of earlier metal consumption. The growth of aluminium use in beverage cans, which are typically recycled at a rate of between 50 and 80%, has contributed to the increase in scrap use, in particular since the life of a beverage can is much shorter compared to other aluminium containing products. Despite varying degrees of scrap use among regions, it is generally lower in the developing world, the reasons being the faster growth of overall consumption in these countries with a proportionally higher consumption share being accounted by products of a longer life. Recycling of tin is also undertaken mostly in developed countries especially in the United States and EEC. However, the share of secondary tin metal in total demand is quite small, compared to other materials like aluminium, accounting only for 3.2% in 1987.*/

Even though relative prices of competing materials constitute an important element for the final selection as an input, also extremely significant are the considerations given to other factor inputs, installation and maintenance costs, specific properties of materials (weight, corrosion resistance, durability, conductivity, visual appearance, manipulative easiness), and performance and quality. In other words, the most relevant cost

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*/ In recent years, steel companies have realized, although belatedly, the importance of recycling and have started recycling activities of the tinplate can. However, there is still great need to increase public awareness.

in material substitution today is the so-called "total package cost". Many new materials are priced higher than the conventional materials they replace. However, these new materials may be preferred because they offer the opportunity to reduce manufacturing costs sufficiently to offset their higher prices. For instance, the competitiveness of the aluminium can, despite the higher price of aluminium, versus the tinplate can rests on low manufacturing costs and recyclability.

In some segments of automobile manufacture, while aluminium is more expensive than steel, savings could be made in the production process, either by using aluminium for the space frame, rather than stamped sheet or by using adhesive bonding techniques, thus reducing the number of welding spots. The hand soldering of household electronic products which requires less solder than more automated production using printed circuit boards. Producers of these products, however, have favored the latter despite higher material intensity because they lower labor costs and insure quality.

The nature of material substitution raises doubts over the traditional thinking that the functional relationship between price and demand is automatically reversible. Rather, if a material loses a particular market, even temporarily, that market might be lost forever and it may be plausible that an industry may not recapture a market lost during a price rise even if its price subsequently returns to a previously low level. Also, for those materials which do not have diversified uses in their applications, prices may rise within certain limits, with little effect on demand, but once a particular threshold is passed, demand may fall dramatically making the use of a competing substitute more attractive.

III. PROCESSING TECHNOLOGIES AND PRODUCTION COSTS

1. Bauxite/alumina/aluminium

Aluminium is the most abundant metal in the earth crust comprising more than 8% of its outer layers. It was discovered in 1825/1827 and the production processes were developed only towards the end of the 19th century. One of the reasons for this belated development is that aluminium does not occur in the natural environment in metallic form, making it relatively more difficult to recognize. On the other hand, though it is a relatively scarce metal, tin was one of the first metals to be used by man, thanks to its properties.

Bauxite, a rock composed mainly of aluminium hydroxide and iron oxide and hydroxides, is the main source of aluminium.*/ Given the genesis of bauxite deposits (weathering of a parent rock), they usually lie at or close to the surface and as a consequence most bauxite mining is open pit. For this reason, the mining is a relatively easy and low cost operation, and the cost of mining in many cases accounts for less than 1% of the total aluminium production costs. As shown later, this is not the case for tin. But it should be noted that different characteristics of the deposit (e.g. karstic versus lateritic, trihydrate versus monohydrate type, the degree of overburden, nature of by-products and impurities) determine the features of the mine operation and ore treatment (consult Table 19 of the aluminium study for bauxite resources and their characteristics, by producing country).

Bauxite is processed into alumina (aluminium oxide) at refineries especially suited for specific types of bauxite. The trihydrate type requires lower temperature and pressure for refining and is therefore cheaper to process than the monohydrate type. Alumina is then converted into aluminium at electrolytic smelters which operate on electric power, the availability and cost of which represents a key element in determining the location of new plants and cost-effectiveness of such operations. Energy costs are known to account for 15-25% of total operating costs.

In this industry, the two major processing steps, the production of alumina and its smelting to obtain aluminium metal, have been governed by two basic processes developed at the end of the previous century: the Bayer process for the conversion of bauxite into alumina and the Hall-Héroult process for smelting alumina into aluminium. These have remained unchanged in their basic chemistry, except for proprietary modifications made by individual producers: they include refinements in terms of economizing energy

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*/ Both bauxite and alumina have uses outside the aluminium sector. Less than 10% of bauxite production is reportedly consumed by the abrasive and refractory industries, while nearly 8% of alumina production is employed for non-metal uses.

use, adding environmental controls and specific technologies associated with bauxite qualities and alumina specifications. As a result, there is a great deal of similarity in the production process worldwide and there is a tendency for the production costs to converge across countries, though the level of development of a particular producing country (labor costs, level of industrialization), energy availability and economic policies figure as important elements of production costs.

Due to the fact that the majority of technologies used in developing countries are developed by leading transnational companies, their subsidiaries tend to adopt new technologies relatively quickly. This relative ease of technology "transfer" to the foreign subsidiaries, on the other hand, could work as a barrier for the "self-reliant" technology development policy pursued by such national companies as Companhia Brasileira de Aluminio (CBA) to enter and compete in the markets of more sophisticated products.*/

Thanks to its diffused nature, when transferred between independent entities, the technology for any stage of processing is available, albeit at a price, from several suppliers, including the major producers but also second-tier producers. Thus the main focus in technology matters is that developing countries receive the most secure and competitive terms available to them during the process of contractual negotiations by having an adequate supply of information on alternative suppliers, cost components and transfer conditions. This would concern negotiations relating not only to technology agreements per se but also to investment agreements negotiated prior to the development of production facilities at any stage between developing country governments and foreign developers, including such areas as further development of processing facilities, host government participation and periodic reviews of negotiated agreements.

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*/ In Brazil, for example, owing to their linkages and international leadership, both Alcan and Alcoa are able to produce more sophisticated products in terms of shapes, quality control, etc. In their case, this is a matter of internal decision making, involving basically a process of adaptation of new technology. CBA, on the contrary, whose policy cannot involve payment of royalties or partnerships, has to go through a process of selection, acquisition, adaptation, absorption and eventually development of technology.

As indicated, the reduction of alumina by electrosis is highly energy-intensive, and therefore reducing energy consumption has been one of the major targets for R & D in the industry. Due to improved power efficiency, during the past two decades electrical consumption has been reduced by an average of 20%. As an illustration, the energy consumption has been reduced from almost 20 000 kwh/ton in the 1970s to 12 900 kwh/ton in the most modern 280 KA Pechiney technology. Even though the average energy consumption is still much higher, as the number of new smelters is not large and among those many still use an older vintage of technology, it has been possible to retrofit old plants and consequently lower their energy requirements. As can be easily seen from Table 7, new aluminium capacity due onstream in 1988 is largely concentrated in those countries with low electricity rates, while high power rates have contributed to a number of capacity closures in 1987.

Other key cost variables for the production of primary aluminium are the price of alumina and labor costs (see Table 8). The price of alumina, ranging from US$ 250 to US$ 350 per ton of aluminium accounts for a significant portion of total operating costs (excluding depreciation and other capital charges), which vary from a below US$ 900 range for the most competitive smelters to the above --US$ 1 000 level for high cost producers.

An examination on technology and production costs of the bauxite/alumina/aluminium industry worldwide points to a relatively favorable position of Latin American and Caribbean producers. In bauxite, though it does not loom significant in total aluminium production costs, the producers of the region are found competitive, with Jamaica having the highest costs. Australia is the lowest cost producer, while its competitive edge is partly offset by high transport costs to overseas refineries. In alumina, Latin American and Caribbean producers appear to have markedly lower costs than the counterparts in North America or Europe. The situation is more heterogeneous for primary aluminium, where production costs of Brazil, mainly due to high energy costs, are at the similar level of the producers in the DMECs, and Argentina and Venezuela figure as very low-cost producers. It was discovered in the aluminium study, however, that for the reasons yet to be clearly determined, labor productivity, both in alumina refining and aluminium smelting, is a substantially lower in the region than in the DMECs.*/

2. Tin

Tin is obtained from tin-bearing minerals of which these are 17 kinds but only cassiterite (SnO_2) which occurs in both lode and alluvial deposits is of commercial importance.**/ In the placer deposits, the cassiterite is relatively free of impurities because it has greater resistance to weathering than the minerals originally associated with it. Primary (or lode) deposits occur generally bonded with igneous rocks, mainly graphite. However, about 80% of all tin mined is reportedly of alluvial origin. In this manner, costs of production in this industry vary not only with the country-specific factors such as availability of infrastructure, tax systems and labor costs but also with the geological characteristics of the deposit which determine the scale

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*/ Since the technology and the operating companies are to a great extent the same worldwide, one would have to seek the factors behind this poor performance in the local countries of operation. Possible reasons could be, among others: (i) comparative over-employment due to lower labor costs and, in the case of state companies, political reasons; (ii) specific difficulties in the technology adaptation process; and (iii) lower level of training.

**/ The definitions of the various types of deposits are as follows: Primary tin deposits are those which occur in association with the parent (or primary) rock. This rock is usually of granitic nature. To be economic these tin bearing rocks must present relatively high grades of tin in localized zones which are called lodes. These primary or lode deposits are usually costly to mine owing to one or more of the following: (a) underground localization; (b) hardness owing to the "freshness" of the primary rock; (c) variability of grade ranging from very rich lodes to disseminated concentrations of cassiterite.

Secondary tin deposits are those formed as a result of erosion or weathering of a parent tin bearing rock. These secondary (also called placer) deposits are classified according to the mode of occurrence and process of formation into: (a) residual deposits when they are formed in situ, that is, directly over the parent rock which may even be found downward; (b) alluvial deposits (usually the richest tin deposits) are formed by water streams and for this reason are usually free of impurities; (c) a residual deposit may be further concentrated by gravity given rise to the eluvial deposit. This may by further concentrated by streams giving rise to the alluvial deposit.

of operation, mining method, grade of the deposit and availability of by-products.

There are essentially four types of mining methods: dredging, gravel pumping, open pit and underground, with the corresponding share of production and potentially recoverable tin by method being 28.1%, 53.4%, 3.8% and 14.7% respectively.

Table 7

ELECTRICITY COSTS VERSUS NEW ALUMINIUM CAPACITY DUE ON STREAM IN 1988, AND CAPACITY CLOSED IN 1987

Country	Electricity costs (US $ mills kWh)	1988 New capacity ($x10^3$ tons)	1987 Capacity closed ($x10^3$ tons)
Canada	5.03	...	...
Venezuela	6.10	215	...
Arabian Gulf	9.64	10	...
Norway	10.83	25	...
Australia	11.44	150	...
Iceland	12.50	...	...
Indonesia	13.00	...	...
United Kingdom	13.10	7	...
South Africa	13.90	...	...
Brazil	17.12	...	...
Sweden	19.40	23	...
France	20.00	...	30
West Germany	21.31	...	44
United States	22.04	...	129
Spain	23.00	...	...
Japan	53.26	...	259
Total		430	462

Source: Wharton Econometrics; CRU; Alcasa. Cited in Martínez Pérez, "The World Aluminium Industry, a view from Venezuela", Natural Resources Forum, United Nations, New York, 1988.

Table 8

PRIMARY ALUMINIUM COSTS OF PRODUCTION, BY COUNTRY
(1987 US$ per ton of aluminium)

	Raw material (of which, alumina)	Energy	Labor	Other	Total operating costs
Argentina	430 (320)	105	60	75	670
Brazil a/	390 (289)	334	79	93	896
Mexico	425 (320)	380	42	68	915
Suriname	390 (280)	110	160	140	800
Venezuela b/	430 (320)	120	60	70	680
Greece (Pechiney)	405 (290)	310	120	85	820
Norway (Hydro Alm)	480 (280)	150	130	90	850
Australia c/	385 (290)	248	140	100	873
Canada	440 (350)	80	200	120	840
United States	380 (290)	490	145	100	1 115

a/ Simply the arithmetic averages (thus not weighted by capacity) of the seven companies cited in Table 25 of the aluminium study.
b/ Venalum and Alcasa.
c/ Alcan and Gove.

Lode deposits are mined essentially through underground methods. They are a high cost process because the metal contained in a hard-rock deposit is accessed by shafts and tunnels and the ore drilled and blasted. Bolivia has always been the major producer by the underground mining and virtually all its production originates from the exploitation of lode deposits. Given this nature of mining and complexity of ore, coupled by the low investment profil and administrative problems, Bolivian tin mines have been characterized as one of the world least efficient operations. On the other hand, one of the largest single underground mines is located in Australia and is rated as an efficient operation, owing to its high level of mechanization. England whose output is also from the underground has higher productivity than Bolivia, because of its greater mechanization and better planning.

Alluvial deposits are mined almost exclusively either by gravel pump or dredging methods. The gravel pump, which accounts for more than 50% of the world output, is traditionally known for its low capital requirement, high labor intensity and high cost of production. Although this technique has been in use for at least seventy years, it has remained essentially the same apart from technological development of equipment. Because of its low capital intensity, the gravel pump has been a widely adopted technique by small producers both in Brazil and Southeast Asia, and has been in many instances the most efficient mining method for exploiting alluvial deposits.*/

Dredging operations, responsible for nearly 30% of world output, are a more capital-intensive technique, carried out mainly by large (national or foreign) companies. They are common in Southeast Asian countries and are also important specially at the Pitinga deposit in the Amazon region in Brazil.

Tin ores are usually treated on or near the mine site to produce concentrates. The concentrates obtained from dredging and gravel pump operations present in general a tin (Sn) grade from 20 to 30%. They are then upgraded to 70 to 75% of Sn in a more complex concentrating plant where relatively more sophisticated techniques such as magnetic or electrostatic separation, acid leaching and flotation can be applied. Given the nature of the alluvial deposits, the recovery rate of their operations is relatively high, ranging from 90 to 95% of the metal content. This contrasts with the recovery rates obtained in the exploitation of underground deposits: the rates at mines in Australia, Bolivia, South Africa and England are seldom

*/ Gravel pumps present the following advantages over dredging methods: i) the topography is relatively unimportant; ii) selective mining can be practiced; iii) capital cost is low; iv) complete extraction of the material is possible; and v) grounds at various depths can be worked with the same equipment.

above 70%, while in Bolivia it can be as low as 30 - 50%. The Bolivian concentrates usually require the roasting to remove arsenic and sulfur, and still lower grade concentrates, also common in Bolivia, averaging between 5 and 25% Sn, might require a fuming process which produces tin oxide dust (with 45 - 60% Sn) from which the concentrate to be smelted in the conventional way.

The first step in smelting tin consists of blending tin concentrates with anthracite, limestone and rich slag charged into the furnaces which are then heated at between 1 250°C and 1 350°C. The resulting raw tin in the molten stage is tapped and poured into refining kettles leaving a left-over slag in the furnaces, which is recycled for secondary smelting. The molten tin undergoes various refining processes for the removal of impurities such as iron, arsenic, sulphur and other elements before it is transformed into finished ingots of a high purity for shipment. Except in certain cases involving more complex materials, the technology for smelting tin is adequate for handling the concentrates currently produced in the developing countries.

An element which affects the overall cost-effectiveness of the mining operation and its profitability is the recovery of by-products. Placer deposits may be associated with tantalum, niobium, rare-earth minerals and zirconium as the most common paragenesis, as in the case of Thailand, Malaysia and Paranapanema of Brazil. Lode deposits, on the other hand, tend to be associated with silver, lead, and zinc, as in the case of Bolivia. These are recovered just after the processing of concentrates at a specific plant, or are from the slags after the smelting phase. However, the producers not integrated into metallurgy usually receive no credit for the content, and even when the operation is integrated, they require special technology and equipment to treat the slags.

There are few published materials on the production costs of the tin industry. The most comprehensive and updated material is the United States Bureau of Mines which estimates operating costs (thus capital charges are excluded) for producing deposits in 1984. At the aggregate (for the 130 mines or deposits examined), the cost of mining ($3.00 per pound of refined tin) accounted for the majority of the net cost (thus by-product credits deducted), estimated at $4.70 (consult Table 46 of the tin study). In this year, Brazil was already a low-cost producer, compared with the Southeast Asian counterparts, which also employ gravel pump and dredging methods. The mining costs in Brazil were lower mainly due to her 2 to 5 times higher grade deposits. On the other hand, the costs of smelting and refining in Brazil were twice as high as those of Thailand and Malaysia, essentially because of the long distance between the mining and smelting facilities. Among the countries producing from underground mines, Bolivia and Australia were the highest cost producers, while Bolivia, besides the highest smelting-refining costs, presented one of the highest tax charges.

According to the more recent estimates, close to 90% of the Brazilian output is considered to be in the range of US$ 3 500 to $ 4 000 per ton of refined tin. The only country displaying costs comparable to Brazil is Indonesia. Though recent Bolivian figures are more difficult to come by, interviews with industrial officials pointed out production costs slightly below the 1988 price average of $ 7 200. Peru's plan is to increase its annual production to 7 000 tons of tin-in-concentrates, maintaining its relative competitiveness at a cost close to $ 6 500 per ton of Sn.

An examination on the composition of production costs therefore make it clear that in the tin industry the mining stage is the most relevant when it comes to efficiency and cost reduction efforts, in contrast to what happens with aluminium which has its key phase in the smelting or further downstream end of the industry. This is due to several reasons, the most important being that the mining cost in tin by its nature accounts for the major share of total metal production costs. Besides, as pointed out earlier, tin is a relatively scarce metal (in contrast to aluminium) and its concentration on the earth's crust in the form of economic deposits not very widespread. Under these circumstances, future competitiveness of such a high-cost producer as Bolivia depends largely on the extent to which they can reduce the mining costs through the application of new or improved processing technologies and administrative reorganization.

Regarding processing technologies, producers tend to give priority to this kind of R & D only when they encounter a critical situation such as the one faced by Bolivia. However, when the crisis arises, the agenda for processing and productivity related R & D is too long and costly, and the time-lag between the decision to undertake such R & D and their sought results may severely affect the performance of those involved.

Recognizing the importance of this line of R & D some producers have in fact suggested that research projects on processing, in addition to those on new uses and products, should be included in the International Tin Research Institute (ITRI) agenda. On this particular issue, some areas identified by Latin American producers as deserving R & D efforts include:

(i) the development of a process to agglomerate the components of the smelter furnace charge (coal, tin concentrate and lime) so as to avoid the problems which arise from the non-homogeneous mixture. This would substantially increase the smelters' productivity without requiring any change in production factors;

(ii) development and dissemination of techniques aimed at recovering valuable by-products; and

(iii) development of more economic means to recover the tin content of low grade concentrates and specially tailings which result from tin mining and are available in very large volumes in Bolivia.

The necessity to modernize smelters has become even more evident given the recently increasing level of impurities in concentrates and the decline of ore grade in general. Progress made in dealing with poorer ore grades has been rather slow. This situation is due partly to the fact that until recently most tin has been derived from comparatively high-grade and clean ores, and partly to the lack of interest in international co-operation to support research efforts to improve metallurgical methods and the development of new techniques.

In concluding, regarding extractive and processing technologies, tin is generally characterized as having a much lower degree of difficulty and complexity than those of the aluminium industry: it is worth repeating that the mining of cassiterite is responsible for almost all tin production and that tin concentrates may be smelted at backyard smelters. This, coupled with a much lower capital requirement, enables the existence of an industry structure where small- and medium-size firms could play an important role, contrary to the case of aluminium. However, as evidenced in Bolivia, whose ore is more complex and of lower grade, the need on foreign technology and expertise might become a key factor determining the future competitiveness of the tin industry.

IV. MARKETING, PRODUCT DEVELOPMENT AND PROMOTION

1. Marketing

The reducing, yet high degree of vertical integration of the aluminium industry has had several important consequences for marketing abilities of developing countries. Firstly, the fact that the majors are almost wholly integrated makes it unlikely that a developing country could become a supplier to any one of these companies unless the company is a simultaneously participant in the producing facility. Secondly, the still relatively small size of the free markets has made it difficult for independent producers to enter the industry at any level, unless they have sales commitments for a substantial proportion of their output.

Under these circumstances, the ability of developing country producers to become more involved in marketing of bauxite and its derivative products depends largely on their capacity to develop marketing relationships with non-integrated or partially integrated processors, to secure marketing control over at least a portion of their production, to take advantage of the processing opportunities available to them in their immediate market area, and to become more deeply involved in the pricing of their output. As most second-tier producers are not fully integrated forward, joint ventures or sales agreements with these companies could offer a greater degree of flexibility for developing countries in production and marketing.

To facilitate such development, there will be a greater need of the collection and dissemination of various types information at the international level. They include the information pertaining to the operation of, and conditions in, spot or short-term markets, including premiums and penalties and the volume of material being sought or available for sale. Other valuable information deals with the identification of buyers and sellers at each stage of processing, together with technical factors, such as product specification, and market-related factors, such as annual requirements or volume available for sale on the free market, investment plans and the structure of consumption up to and including semi-fabricated products in world and regional markets.

The degree of need for marketing infrastructure, capital and human alike, will depend in part on the type of development strategy envisaged by developing countries, in particular those in Latin America and the Caribbean. Either the region's exporters remain suppliers of bulk products, in which case investments in marketing systems would be relatively small, relegating their sales principally to traders with prices close to commodity exchange quotations. Or they might diversify into more specialized products such as special alloys, which would call for the establishment of more ambitious marketing systems. In the case of the latter, it would probably imply greater efforts to penetrate major markets for semi-manufactured products.

There are few other commodities in the mineral and metal sector in which developing countries play a more active role in the marketing than in tin. A major factor responsible for this has been the establishment of domestic tin smelters, providing producers with better opportunities to participate in a large share of the trading of their tin. Several producers now run their own sales offices or trading companies in major markets to handle the marketing of their own tin, the most often cited being the Malaysian Mining Corporation, P.T. Timah of Indonesia. The trading arms of these companies were also reported to have used in a significant way the hedging facilities provided by the LME until the termination of tin futures in October 1985. Nonetheless, despite such efforts, the influence of trading companies has remained generally strong, as they handle important quantities of developing countries' tin exports, as in the case of Bolivia. The strong foothold of the trading companies arises not only from the larger proportion of the trade which they handle but also from the more efficient marketing services provided by them (e.g. financing, credit extension, market research facilities, etc.)

In spite of the progress made over the past years, the producers are facing a number of market forces which continue to hinder their participation in marketing activities. It is often expressed by a few developing countries, where processing facilities already exist, that problems affecting their participation in downstream activities do not lie in processing *per se*, but rather in the marketing of the processed products. This view, also shared by those involved in the aluminium industry, highlights the importance of marketing if efforts towards industrialization, based on raw materials, are to make headway in the Third World. The areas of marketing and processing are intricately related, since the possibilities for processing before export depend on the ability to secure beforehand market outlets for the processed product. Prior assurance of market possibilities is often a requisite for raising the necessary investment funds.

Another important area in marketing relates to commodity exchanges. These exchanges have played a central role in the price formation and marketing of tin,*/ and the importance of these functions for aluminium has drastically increased in recent years.**/ From the point of view of developing countries, however, there are several issues requiring international attention, namely the possible under-representation of producer interests, the strong market influence exercised by large trading entities and the increasing disruption caused by speculative forces. A higher degree of participation by developing countries in these institutions have been, in turn, hindered by the difficulties in allocating sufficient foreign exchange for such purposes, the lack of expertise on their operations and lack of familiarity with their mechanisms, and the great distance separating most producers from the market.

With the development of information processing, leading to a spreading practice of "program trading" and "round-the-clock" trading among commodity exchanges, commodity markets have become more than ever an integrated part of overall financial operations for international investors. This feature has made it more difficult but at the same time increased the need for developing

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*/ From the time of its suspension in October 1985 up until the recent relaunching of tin futures contract on the LME in June 1989, only the Kuala Lumpur Commodity Exchange had a tin futures contract, based on five brands produced by Malaysia, Thailand and Indonesia. The reintroduction of tin trading on the LME has meant that producers, dealers and consumers will again be able to have a "transparent" marketplace.

**/ Apart from its importance for price discovery functions and hedging operations, the LME is considered still as a "last resort" in physical markets. However, coming into existence of LME warehouses in Singapore, Japan and North America, in addition to the long-time existing ones in Europe, might become a more attractive marketing vehicle for Latin American producers.

countries to create a market intelligence intra-structure competent enough to hedge risks and to assess the fairness of price levels, contract terms and profit margins sought by consumers. In this sense, international or regional action may be considered to assist developing countries either to elevate the level of their participation in these markets already existing in the DMECs or to establish and/or run their own.

2. Product technology and promotion

A contrasted performance in demand between aluminium and tin, especially during the period 1960-1979, is related to the high degree of industrial integration still prevailing in the industry of the former. The most marked features of the aluminium industry have been: the stable pricing regime, at least up until recently; the orderly development of production capacity; a high degree of direction and concentration in R & D aimed at expanding its use; and the ability of major transnationals to invest in manufacturing facilities to bring new products to markets. On the other hand, efforts made in tin to discover, develop and promote new uses have not proven sufficient, and rather emphasis was placed on the survival of uncompetitive mines protected by artificially high prices.

The historically high degree of vertical integration in aluminium, with the free markets of the related products being relatively small, has had a favorable consequence in product promotion for the industry as a whole. The comparatively closed production chain has facilitated the major producers to know the needs of end-consumers, to be able to find ways of serving those needs and to put in practice more orderly production plans. Throughout the post World War II period, or even prior to that, the leading aluminium producers addressed their efforts to expanding demand and research on new uses and applications for their product. To do this, the companies set up large technical laboratories alongside their operations. With improved technologies and the low price in real terms, they were able to pursue an even more aggressive campaign to expand their markets, especially by penetrating the tin, copper and steel markets. Their particular industrial structure has enabled them on the one hand to act expeditiously to adjust their output to the drop in demand by lowering production and adjusting stock levels, and on the other to become more aware of the need to continue developing new markets and expanding those already in existence. Moreover, rising energy costs have promoted the producers to strengthen technological research to improve efficiency and also to set up scrap collection and recycling centers.

In tin, in contrast, owing to the intrinsic properties of the metal which dictate its main end-uses as an alloying element or as a coating material and to the geographical segmentation of the producing and consuming areas, the marketing of tin-related products has mostly been undertaken by trading companies, and their pricing is done on an arm's length basis. The companies trading in tin concentrates and metal are mostly dealers who handle more than one material with these products making up only a small proportion of their total turnover. The market structure in tinplate is largely dominated by the bigger companies on both supply and demand side, but there is rarely either forward or backward integration between tinplate manufacture and canmaking. The tinplate manufacturers often offer both tinplate and tin-free steel (TFS), while canmakers operate a number of dual-production lines, providing necessary flexibility to switch production to either tinplate or aluminium cans. One particular aspect of the packaging market is then its notorious lack of product loyalty, a situation which can lead to the substitution of tin by other materials.

The following description of technological developments in the metal can market is a testimony of the fact that, unlike the case of the aluminium producers, raw material producers of tin have had rarely participated in the stimulation or creation of demand. In the early 1950s, tinplate cans fabricated by the three-piece technology with a soldered side seam monopolized the market. Aluminium could not be economically soldered and thus precluded from conventional canmaking technology. In 1958, two beverage producers introduced the impact extruded two-piece aluminium can. While this technology allowed aluminium to be used as a can making material, three-piece tinplate cans retained their competitive edge thanks to their lower costs. In 1963, Reynolds Aluminium first produced an aluminium can using the draw-and-iron process, which proved to be the efficient two-piece technology. Although the price of aluminium increased between 1950 and 1963 while the price of steel remained fairly constant and the price of tin fell, the two-piece canmaking technology enabled aluminium to compete effectively with tinplate.

This aluminium challenge, in turn, forced steel producers and canmakers either to improve upon the three-piece tinplate can or find an alternative container. Steel makers responded by introducing the tin-free steel (TFS) can, a chrome-plated steel can. Realizing the potential of TFS and the threat it posed, aluminium canmakers introduced in 1969, two years after TFS cans appeared, two-piece aluminium cans from H19 alloy, a full hard temper material that was stronger and lighter than previous alloys. In response to this new challenge from the aluminium industry, steel producers and canmakers began experimenting with two-piece steel cans. As can be seen, tin producers, not figuring in any way in these battles of new product introduction, their future destiny in this one of the most important end-use sectors remained at the mercy of other producers, whose loyalty to tin diminished quickly.

In sum, tin producing countries' considerably low success in promotion of consumption stems from the fact that the metal is an input for manufactures or semi-manufactures, who not only have no links with raw material producers but also produce items made of other metals, thus with little interest in promoting its consumption in preference to any other metal. On the other hand, tin producers, who are directly affected by tin usage, do not have access to final consuming markets, where the demand is actually determined. It is difficult for them to promote tin products because such promotion requires of efficient marketing and knowledge on the requirements of end-users. Moreover, due to their "public-good" nature, unless they are undertaken jointly by producers, these promotion efforts might be circumvented by the problem of "free riders".

In view of the changing technological conditions affecting the tin market, the most important task facing the tin industry is to take measures for increasing its demand. These measures would require the strengthening of both research and promotional efforts to maintain and subsequently increase the share of tin consumption in the world market. The measures to increase its demand should include two areas: (i) development of new uses of tin, and (ii) the reversal or the containment of the tide of substitution of other materials for tin. In the first area, the industry has already established institutions, such as the ITRI as the most important one, and has had remarkable successes in developing new uses for tin --particularly, chemical compounds. The second area has to cover two industries --tin and tinplate. As seen in Chapter III, the tin industry needs to make continuous efforts to reduce production costs and to set prices competitive to other materials. The tinplate industry should encourage competition and set tinplate prices competitive to other materials.

A fundamental strength of the aluminium industry in research and promotion is the amount of funds which a company like Alcoa or Alcan allocates to these objectives --major companies spend more than US$ 100 million annually-- and the nature of those efforts. R & D activities of the majors at present center around the following three broad categories: (i) work aimed at reducing production costs, mainly by the introduction of processing changes; (ii) development of new alloys for specific end-uses; and (iii) basic materials research. Among the three, the last category has assumed increasing importance as most major companies in recent years have followed a strategy based on horizontal integration and diversification.

In tin, research on new and traditional uses has been relegated to independent centers such as the International Tin Research Institute (ITRI), since its establishment in 1932. Its aim is to develop the use of tin by carrying out scientific and technical study of the metal, its alloys and compounds and of industrial processes which use tin or may provide future markets. Although the Institute has represented a seminal initiative and a major joint effort, its annual budget is less than US$ 5 million, an amount minuscule to what a single leading company of the aluminium industry invests in R & D.

The International Tin Study Group recently constituted (April 1989) under UNCTAD auspices, does not specifically deal with technical aspects of the industry and instead its objective is to "ensure enhanced international co-operation in tin by improving information available on the international tin economy and providing a forum for intergovernmental consultations on tin". Other functions comprise undertaking of studies on a broad range of important issues concerning tin, including measures designed to expand world consumption of tin. The Group's terms of reference provides for its association with the

Common Fund for commodities as an "international commodity body" for sponsoring projects that the Fund can finance out of its Second Account for development purposes. However, the same terms of reference also contains a provision that specifically rules out any power, directly or indirectly, to enter into any tin contract for purpose of trading in tin or any other commodity or product or any contract for futures transactions.

Although on the global scale, the tin industry has identified that R & D on consumption should be one of their first priorities, Brazil and Bolivia are not at present ranking this as an issue of utmost and immediate concern. Brazil, having a comparative advantage to other producers, seems quite happy with the present outlook of the market, while Bolivia, for different reasons, is completely absorbed in the task of transforming its industry into a competitive and profitable one.

As suggested above, the tin industry seems to be placed at a comparative disadvantage in relation to the more vertically integrated metal industries as that of aluminium, where production is concentrated in the hands of a limited number of companies. These companies are willing to devote much larger resources on R & D and publicity since the accruing gains are more directly visible to them. Considering the meagre financial resources on R & D, and due to the intrinsic properties of tin basically as an alloying element in metals and chemicals which circumvents the direct perception by producers of benefits accruing from such activities, there is a need of intergovernmental assistance, within the existing institutions or in addition to them, which could be provided to tin producers to overcome the difficulties of mounting and adequate promotional campaign.*/

Another important area of international co-operation relates to price stability. In view of the fact that tin price instability adversely affects its use, any promotion strategy must involve the drawing up of an appropriate

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*/ Research efforts in the tin industry will be needed especially in metallurgical processes for the reduction of production costs, the development of new uses of tin and the slowdown of the substitution of tin by other materials. The South East Asia Tin Research and Development Center (SEATRAD) first initiated and financed by the UNDP, to co-ordinate and promote research and training in mining, mineral processing and smelting of tin, is a good example, which could also be adopted in the Latin American region.

pricing policy. This strengthens the importance of gathering support for achieving international agreements, whether they are arrangements involving both producer and consuming countries, producers' associations or other schemes, whose main goal is to establish price stability. Only through a reduction in price instability, short-term and long-term, efforts to foster consumption, to maintain the competitiveness with other substitutes, or to find new uses can be sustained. Forward integration into more advanced fabricating processes should also help reduce price instability. Price stability at an equitable and remunerative level should also reduce the growing concern of low-cost producers like Indonesia and Brazil that high prices could lead to the reopening of old mines, which in turn could bring back the problem of oversupply.

The foregoing comparative analysis on aluminium and tin does not of course suggest that the former is free of problems. The general consumption trend and the slowing-down in the rate of substitution for and by other materials in recent years have to be contained. This type of concern, for example, had led the International Bauxite Association (IBA) to adopt the promotion of aluminium consumption as one of its high priorities and has in fact started to contact international organizations for possible funding. From a realistic view, it could be argued that any intergovernmental action on R & D on promotion of aluminium consumption would have a modest impact, compared to the activities of the major producers, who undertake these efforts efficiently with ample funds. However, it should not be excluded that measures specifically oriented towards solving the problems of developing country producers could have significant benefits. To support the objective of promoting consumption in Latin America, not only independent efforts among the regional producers but also the initiatives of the major producing companies to transfer part of their R & D now undertaken in the DMECs or to engage in R & D beyond the mere process of adaptation are encouraged.

V. OPPORTUNITIES FOR AND CONSTRAINTS OF INCREASED PRODUCTION

1. Exports to markets outside the region

As sustained in the earlier chapters, the trends in aluminium already observed during the 1970s and 1980s will continue in the 1990s: relocation of alumina refineries close to bauxite mines and of aluminium smelters to areas where low-cost energy is abundantly available. Given its resource endowment and cost-effectiveness, the region as a whole should ascertain its status as a major exporter to the rest of the world at all stages of production. With its growing capacity, the region will remain basically oriented to extra-regional markets, even against rapidly growing internal consumption.

The importance of extra-regional markets is also valid for tin. The restructuring of its industry, already underway in the 1970s but more evident in the 1980s (e.g., rationalization of the high-cost producers and the emergence of new low-cost producers) means the relative decline in output for both concentrates and metal in the DMECs in the future. This should be compensated for by higher output in Asia and Latin America. Nonetheless, against the background that the largest consuming markets for primary tin metal are and will be in the DMECs --North America, the EEC and Japan will likely have a share of 64% in total world tin metal imports in 1995--, the world tin producers, including those from the region will remain basically oriented towards and will have to stay competitive in these markets. Opportunities also exist in other developing regions, especially in Asia, while the socialist countries of Eastern Europe should continue as large net importers. Worldwide tin consumption is expected to show a very modest increase and this increase is likely to come mainly from developing countries as they expand their canning facilities to meet the increasing demand for canned foods and beverages. Other areas offering good prospects of growth in the Third World are solder in the electronics industry and the chemical sector.

As regards barriers to trade towards the markets outside the region, the exports in aluminium as well as in tin are subject to relatively limited tariff and non-tariff measures in the DMECs. Where positive tariff rates exist, GSP rates are generally zero. While bauxite imported from developing countries do not face tariffs in any DMEC, some countries levy import tariffs on alumina. Tariffs, sometimes up to 25%, are also imposed on a variety of semi-manufactures and finished products of aluminium. Similarly the tin exports of developing countries, including those of the region, are accorded duty free on ore and concentrates by the DMECs, but most industrial countries apply tariff protection to further stages of processing and a number of non-tariff measures as quantitative restrictions, legal and administrative measures such as licensing and requirement of specific domestic contents in finished goods.

On the other hand, tariffs are generally higher in developing countries where a large portion of the future consumption expansion is expected to take place. These rates also tend to increase with the level of processing. In this light, reduction and/or elimination of these barriers, through trade preferences among them, including the application of the Global System for Trade Preferences (GSTP), should help such trade expansion.

Equally important, if not more so, for trade expansion outside the region is the marketing aspect, which was touched upon earlier in Chapter IV. In aluminium as well as in tin, Latin American exporters mostly lack the extensive marketing network necessary to penetrate new markets, to achieve the best possible sales conditions and to keep abreast of new market developments.

2. Production for regional consumption

As discussed earlier, aluminium and tin per capita consumption, both for primary and semi-manufactured products, is substantially low in the region. Tinplate apparent consumption has actually declined. This suggests that there exists for both metals a consumption potential that has yet to be realized. A strong regional demand of aluminium of recent years in its major using sectors, such as transport, mechanical and electrical engineering, building and construction and packaging, might very well continue and might be greater, should the austerity economic programmes adopted in the majority of the countries be softened. In tin, there is growth potential particularly in tinplate, as the high population growth rate should lead to a greater expansion of the packaging sector, as in canned food.

Obviously, these prospects will be highly determined by the future performance of the economies of Latin American and Caribbean countries. Also important is the future competitiveness of these two metals, between themselves and in relation to other materials like glass, paper, plastics and other metals. Reduction of existing barriers to intraregional trade, to be mentioned later, should also favor the expansion of regional production.

Though it is out of scope of the two studies to analyze the impact of increased regional production on forward and backward linkages, it can be safely concluded that the expansion in activities related to aluminium and tin should encompass sectoral policies which on the one hand utilize a series of final demands which will have an intensive and rational use of these metals and on the other enhance establishment of some upstream activities. In aluminium, not only the energy sector but also the petrochemical sector (e.g., petroleum coke, caustic soda) should be favorably affected by regional expansion. At the same time, the increasing capacity of the larger regional economies to produce capital goods required by the industry might be promoted: it is important to note that in the case of Brazil, 95% of mining equipment and 90% of machinery and equipment for refineries and smelters required by the industry are produced locally.

Arguments for promoting backward and forward linkages of the tin industry are more complex. This is related to the relatively low tin content of the goods in the manufacture of which it is used as an input. Tin constitutes a neither necessary nor significant part in the production of some of the tin-using intermediate products, so that the domestic availability of tin per se does not confer an important advantage to the tin-producing developing countries in the production of the intermediate goods. In addition, the high value of tin per weight facilities international trade of this metal and natural resource endowment is not a crucial factor in the determination of fabricating plant sites. These factors taken together suggest that the processing of tin further downstream requires complementary metals such as the steel base for making tinplate and various metals like lead, antimony, silver, etc. for tin alloys. Unless the supply of the required metal is available on economic terms, the establishment and its sustained growth of processing facilities beyond the stage of smelting in Latin American tin producing countries would be difficult.

In most of the countries in the region, demand for tin is a function of demand by two major sectors namely tinplate and solder alloys. The Brazilian case, where almost 77% of total tin production in 1987 was accounted for by these two sectors and tinplate had the largest share of over 40%, is a representative case for Latin America (for individual Latin American countries, see Chapter I of the tin study).

As regards solder alloys, some supply of the required complementary metals is available from domestic sources: for example, lead in Bolivia and Brazil and silver in Bolivia, Peru and Mexico. In these cases the setting up of processing capacity seems comparatively easy. With respect to tinplate, imported inputs play an important role: for instance, steel sheets are imported in Peru for the manufacture of tinplate, and Argentina, Chile, Colombia and Venezuela import tin metal for the manufacture of the same. However, the processing of downstream products with imported materials tends to raise production costs, rendering the operation uncompetitive compared to the more integrated producers like Brazil. Actually this is the case of most Latin American tinplate industries, with the exception of Brazil, which encounter serious financial difficulties. This situation of generally high production costs is further exacerbated by price distortions created by price controls and subsidization policies. Consideration on cost effectiveness of the regional tinplate producers is important when viewed against the worldwide overcapacity in tinplate production capacity */ and its expected capacity increase in developing countries such as Brazil, Argentina, Peru and Malaysia.

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*/ World installed tinplate production capacity is estimated for 1987 at 20.1 million tons, which is well in excess of world demand of 11.5 million tons. The DMECs had a 84.5% share while developing countries' capacity was, although expanding, still relatively small. Although tinplate capacity in Latin America and Asia is more or less the same, the output in the former has been larger, due to increased production in most tinplate producing countries, particularly Argentina, Brazil, Chile, Colombia and Peru.

3. Intraregional trade

Salient features which are generally applicable to the aluminium and tin industries of the region include the already mentioned high export ratio to extraregional centers, the low level of interaction at the regional level (investment, technology and research, trade and specialization) and generally unsuccessful attempts at bilateral and multilateral co-operation through failure to adequately exploit complementarities. These are also accompanied by such common features as the low development of downstream activities and low level of per capita consumption of these two metals.

A study by D. Morrison */ sustains that there are high potentials for regional co-operation in the aluminium industry. His arguments derive first from the existence of under utilized bauxite and aluminum production capacity in the Caribbean coinciding with the expansion of smelter capacity in Venezuela and Brazil and the availability of idle fabricating facilities primarily in Mexico, and second from the comparative advantages enjoyed by the Caribbean countries in bauxite and alumina production and by Venezuela and Brazil in aluminium. The dilution of ownership and control by the major producers at the primary stages of the industry and the consequential increase in downstream activities on the one hand, and the increasing role of the State sector of the various regional producers in the industry should also work in favor of regional co-operation. Also, the comparative advantages of the region in the production of raw material inputs for the alumina and aluminium sectors (e.g., caustic soda, petroleum coke), enhanced by the declining level of investment by extraregional producers of these products, are another favourable element. Furthermore, the increasing sophistication of trade regimes such as countertrade and other payment mechanisms in international trade as well as the increased use of multilateral and bilateral reciprocal credit agreements should also favor regional co-operation.

To get some insight into the potential of such co-operation in aluminium, it is useful to refer to some tables contained in the aluminium study. As can

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*/ Morrison, Dennis, Study on the Identification of Possibilities of Production Complementarities among the Producers of Aluminium and Nickel in the Caribbean Region, UNIDO, ID/WG.481/4 (SEC), January 1989.

be seen in tables A 16-19, in 1987, most of the bauxite imported by the countries in the region (76%) came from the region itself, while this was the case for only 15% of alumina imports. In aluminium the corresponding rate was 61% whereas for semi manufactured products it was only 31%. Given the actual production levels, theoretically speaking, it was possible to cover all the needs of these products from regional sources, not mentioning technical or commercial non-complementarities of such trade reorientation efforts.

Crude estimates of regional consumption of semi fabricated aluminum products also indicate that Latin America was in a deficit position of over 200 000 tons in 1985. Hence the region imported products accounted for 25% of consumption while capacity utilization stood at 65%. While the installed capacity does not cover the full range of products needed in the region, it can be reasonably assumed that a higher proportion of the region's demand than at preent could be covered by regional production.

This type of speculation, of course, does not take into account, for example, the fact that over 33% of capacity is owned by the transnational majors and is therefore subject to their worldwide production marketing dynamics. Neither taken into consideration is the uncompetitiveness of some of the facilities. However, the problem of capacity utilization appears to be crucial to the future development of the industry in the region, as the apparent under-utilization of semi-fabricating capacity affects negatively upstream on the production of smelted and refined stage and downstream on the durable goods and final use industries, thus lowering the overall efficiency of the industry.

A high "theoretical" potential in trade redirection towards the proper region can be also demonstrated for tin. In 1987, the region as a whole imported 5 100 tons of tin concentrates while only 500 tons were satisfied by regional output. For tin metal, out of 3 100 tons of metal imported from all origins, only 1 600 tons came from the region. The case was more drastic in tinplate: out of 194 000 tons imported, slightly over 21 000 tons originated from the region. Considering the very high idle capacity rates both in tin metal and tinplate worldwide and in the region, the existing capacity is more than enough to satisfy the regional needs without further investment for capacity expansion.

In 1987, the installed tinplate production capacity of the region was estimated 1 563 000 tons against the apparent consumption of the product 1 124 700 tons. The capacity utilization rate for the region was estimated to be around 67%, whereas it was 55% in the DMECs whose total installed capacity and apparent consumption were 16 942 000 and 7 627 000 tons respectively. Against this huge idle capacity worldwide, it is necessary for the producers of the region to apply appropriate measures to improve efficiency and to reduce production costs. In this sense, revision or elimination of domestic price controls and subsidies in tinplate, a practice common in the region, should have a favourable impact on efficiency.

The reasons for modest intraregional trade in the products related in aluminium and tin include the limited size of most regional markets technical difficulties arising from different complexities of ores,*/ the existence of long standing contractual and commercial relations, transportation difficulties,**/ time consuming foreign exchange and customs procedures, tariff and non-tariff barriers and the difficult financial situation faced by most countries in the region via cut-backs in imports of almost all goods. An additional factor for tin is pricing and subsidy policies already mentioned, prevalent in the majority of tin products producing countries, aimed at containing inflation and subsidizing products of common daily basket such as tinplate in the food packaging sector. Corrective measures on these aspects will certainly facilitate intraregional trade in aluminium and tin.

Regional co-operation between the producing companies of the region could assume different forms. Joint efforts might be called for to enhance R & D, market analysis, product development and promotion of consumption on these two metals in order to identify needs specific to the region, possibly through creation of regional associations of producers and fabricators. There also exist a number of possible joint-venture prospects. As earlier indicated, in

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*/ Tin smelters in Brazil treat only alluvial high grade tin and are not equipped to treat Bolivian or Peruvian low grade concentrates.

**/ The lack of adequate, reliable and cheap transportation means in Latin America hinders the development of greater economic and trade interaction in the region. The building of a train link for example between Bolivia and Peru would reduce considerably the costs of transportation between the two neighboring countries and facilitate greater commercial exchange.

aluminium, the existence of unutilized capacity at the semi-fabricating stage in Argentina, Mexico and Venezuela and the planned expansion of primary metal production in Venezuela might call for a feasibility analysis. The construction of a joint caustic soda and petroleum coke plant could be also studied. The establishment of joint-venture smelters of the Caribbean may deserve further analysis. In tin as well, a better utilization of existing installed capacities at the regional level should have a favourable impact, as it has been shown in the agreement between a Peruvian and a Mexican firms to treat concentrates of the former in the smelter in the latter. There are also opportunities to set up processing plants in the area of tin chemicals. Brazil and Mexico are fully equipped to establish and expand this sector and this could be achieved through joint-ventures with firms of other countries.